

RAN-2103000205021004
T.Y.B.Sc. (Sem. - V) Examination October - 2025
Physics (Paper IX - old Course)
Statistical Mechanics and Special Theory of Relativity
[Total Marks: 50
સૂચના : / Instructions

- (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

Seat No.:

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Student's Signature

Q. 1 Each question carries one mark only. 10

- What is the dimension of phase space for two particles which are moving randomly?
- Which quantity remain unchanged in isochoric process?
- In how many ways, '4' distinguishable particles can be distributed in two identical compartments?
- The energy density is a function of _____. (entropy, temperature)
- What is the difference between kinetic theory and thermodynamics?
- Give the statement of Newton's law of cooling.
- How can you obtain the inverse Lorentz transformation?
- If the value of $(1-\beta^2)^{1/2} = 0.995$ then velocity $v =$ _____
- In a Michelson – Morley experiment if we move one mirror by a distance 3λ that corresponds to path difference of _____
- Why should we choose the electromagnetic signal to synchronize the clock.

Q. 2 (a) Attempt any one. 07

- Derive the Planck's law for black body radiation.
- Derive the Rayleigh – Jeans formula for the distribution of energy in black body radiation.

(b) Attempt any one. 03

- Discuss the graph of spectral distribution of radiant energy.
- A spherical blackbody of radius 4cm is kept at a temperature of 227 degree Celsius. Calculate the wavelength at which maximum energy is radiated.
Given $\sigma = 5.672 \times 10^{-8} \text{Jm}^{-2}\text{K}^{-4}\text{S}^{-1}$.

Q. 3 (a) Attempt any one. 07

- Explain the concept of phase space and deduce the phase trajectory for simple harmonic oscillator
- Deduce the wave function equation and energy eigen equation for a free particle in a one dimensional box and using it explain how the electron between the lattice point can be described.

- (b) **Attempt any one.** 03
1. Write a short note on statistical interpretation on entropy.
 2. Suppose you flip 5 thousands identical coins and find that two of them end up standing on edge. If you flip one more such coin, what is the per cent likelihood that will end up standing on its edge?
- Q. 4 (a) Attempt any one.** 07
1. Describe the Michelson Morley experiment.
 2. Describe the importance of reference frame and prove that for a Galilean transformation Newton's law of motion is invariant.
- (b) **Attempt any one.** 03
1. Lorentz - Fitzgerald contraction hypothesis.
 2. A passenger walks forward along the aisle of a train at a speed of 3.2km/hr as the train moves along a straight track at a constant speed of 56.5km/hr with respect to the ground. What is the passenger speed with respect to ground?
- Q. 5 (a) Attempt any one.** 07
1. Derive the Lorentz transformation equation.
 2. Using Lorentz transformation equations derive the formula for relativistic addition of velocities.
- (b) **Attempt any one.** 03
1. State and explain the basic postulate of special theory of relativity.
 2. The length of the spaceship is measured to be exactly the half of its proper length. What is the speed of the spaceship relative to observer on earth?
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